LAW OF GAY LUSSAC

MED 16.04c

Material:

Item-no.	Qty.	Description
C1010-1H	1	Beaker glass, 1000 ml, tall form, Boro
P2700-2DL	1	Lid for calorimeter, without stoppers
C7320-1A	4	Stopper silicone, 10/14/20 mm
C7320-1B	1	Stopper silicone, 10/14/20 mm, 1 hole
P2710-GK	1	Gay Lussac - Hollow-sphere with nose
C7445-3S	1	Hose, silicone, D=3/6 mm, L=100 cm
C7414-2C	1	Hot plate, small, 500 W
DE722-2D	1	Manometer, differential, "inno"
P3120-4A	1	L-shaped assembly platform
DE723-2T	1	Thermometer, differential "inno", 150 °C
DT202-5S	1	Thermo-sensor, with handle, DIN
P3120-5B	1	S-shaped assembly platform

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Purpose

The thermal state of a gas is determined by the quantities pressure, volume, amount of substance and temperature. The relationship between these quantities is given by the thermal equation of state:

$p \cdot V = n \cdot R \cdot T$	p….Pressure V….Volume n….Mol R….Gas constant; R = 8,3 J mol^{-1} K^{-1} T….absolute temperature

If V and n are constant, it follows from the thermal equation of state that p and T are directly proportional to each other. This conclusion is known as the "Gay Lussac Law".
The aim of our experiment is to demonstrate the direct proportionality of p and T (assuming n = constant and V = constant) and also to estimate the value for absolute zero.

Preparation

- fill up the 1000 ml beaker half full with cold water
- connect the silicone hopes to the nose of the Gay Lussac sphere; the hose has to be connected air tight
- move the free end of the hose through one of the holes from the lid
- place the sphere inside the beaker and put the lid on the beaker afterwards (the sphere has to be completely covered with water)
- place the stopper 10 / 14 / 20 mm over the temperature sensor, afterwards put the stopper opposite of the hose into the lid
- make sure that the tip of the temperature sensor is neither touching the wall of the beaker nor its bottom
- place the "inno" thermometer on the S-shaped assembly platform and connect the temperature sensor to the "t1"-bush; afterwards the switch in the middle is moved to the left position and the "inno" thermometer is switched on
- place the "inno" Manometer on the L-shaped assembly platform and set the measuring range to "100 hPa"
- turn on the Manometer and tare (set to 0), afterwards connect the hose with the "overpressure"-connector of the Manometer

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Experiment
The air in the sphere takes on the temperature of the water after a short time (approx. 2 minutes, observe the Manometer!).

Note the temperature and pressure in the first column of the chart below.

T (°C)					
p (hPa) at the Manometer					
p (hPa) Manometer + air pressure					

Switch on the heating plate and set the heating switch to the highest level.

The water is now being heated up. If there are several temperature levels (e.g. around 20, 40, 60 and 80 ° C), the temperature and the pressure displayed are also entered in the columns of the table.

The air pressure on the manometer is a relative value. In order to obtain the absolute value, we read the current air pressure from a weather station nearby or explore the current value of the air pressure at our location on the Internet. The value of the current air pressure is added to the value displayed on the pressure gauge (from the 2nd row), and then entered in the 3rd row of the chart (pressure gauge + air pressure).

Now we can transfer the values obtained to a diagram.

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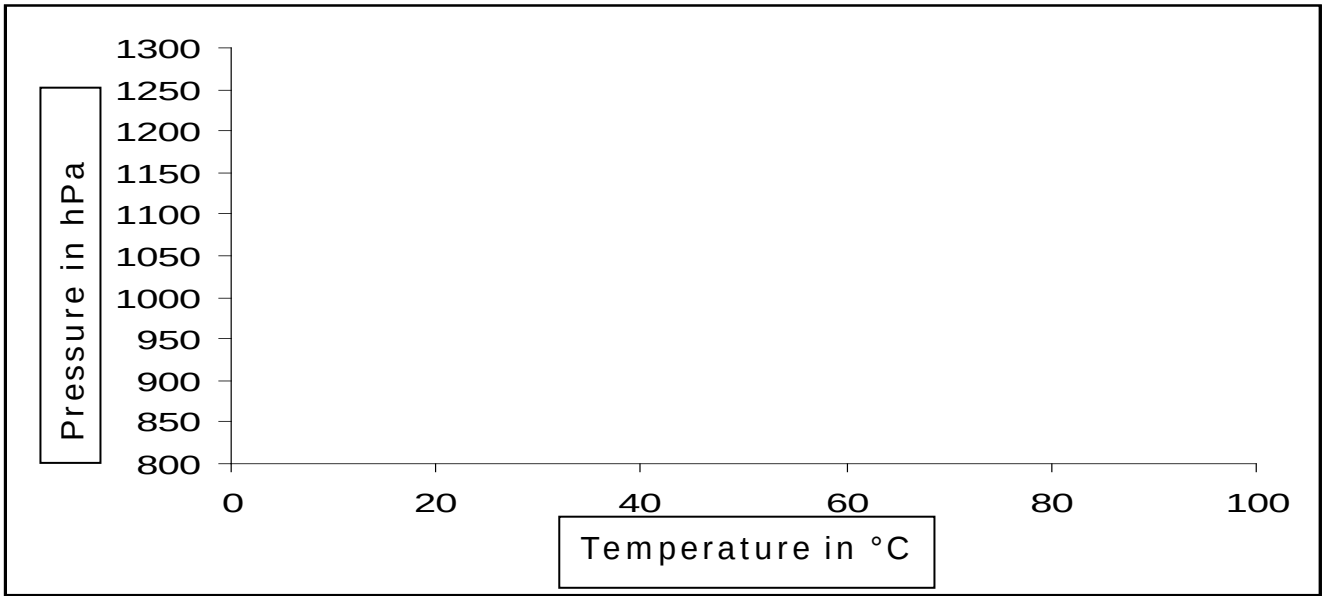

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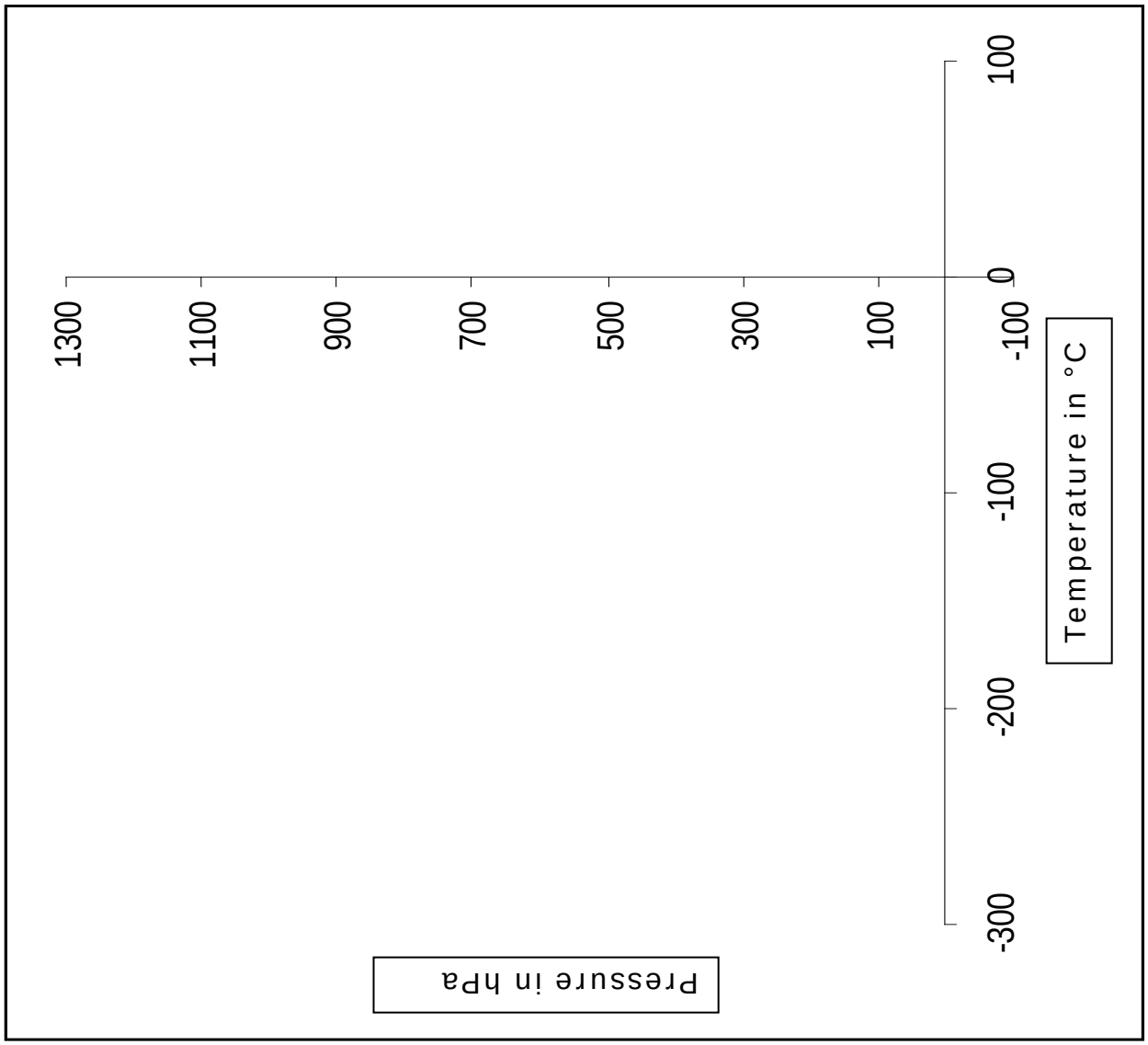
To estimate the absolute zero point transfer the value pairs of our chart into a larger diagram:



Since the pressure and the temperature are directly proportional to each other the determined points should result in a straight line.
We extend this straight line with a ruler into the negative temperature range.
What temperature do we get at a pressure of 0 hPa?

Result

The absolute zero point is −273.15 °C.
Of course, the determined value will differ. Due to the simplicity of the structure there are several reason that cause a deviation.

Note

On the basis of the measured values, the absolute zero point can also be determined by extrapolation.

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